

CLAIMS**WHAT IS CLAIMED IS:**

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1. A method for establishing a protection path for a failed link between first and second nodes in a mesh network, wherein a transfer of information from the first node to the second node is disrupted by the failed link, the method comprising:
- establishing an alternate path from the second node to the first node via a destination-to-source communication channel, wherein the destination-to-source communication channel is established through one or more alternate nodes beginning at the second node and ending at the first node;
 - executing a switch function at each of the alternate nodes traversed by the destination-to-source communication channel to allow source-to-destination information traffic flow from the first node to the second node along the alternate path defined by the destination-to-source communication channel; and
 - switching the information traffic flow at the first node from the failed link to the alternate path when the destination-to-source communication channel is established at the first node.
2. The method as in Claim 1, wherein the mesh network is an optical mesh network, and the information transferred comprises optical signals.
3. The method as in Claim 2, wherein the optical mesh network is an optical mesh network incorporating wavelength division multiplexing whereby multiple optical signals each transmitted at a different wavelength are transmitted on a single optical fiber.
4. The method of Claim 3, wherein executing a switch function comprises optically switching the wavelengths of one or more of the optical signals of the failed link onto optical fibers establishing the alternate path.

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2 5. The method of Claim 4, wherein optically switching one or more of the
3 optical signals of the failed link comprises switching the one or more optical signals to
4 alternate ports of an optical cross-connect.

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6 6. The method of Claim 3, wherein executing a switch function comprises
7 switching the optical signals of failed optical fibers onto alternate optical fibers to
8 establish the alternate path.

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10 7. The method of Claim 6, wherein switching one or more of the optical
11 signals of the failed fibers onto alternate optical fibers comprises collectively
12 switching the one or more optical signals associated with the optical fibers of the
13 failed link to different ports of a fiber cross-connect.

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15 8. The method of Claim 1, wherein establishing an alternate path from the
16 second node to the first node comprises routing the destination-to-source
17 communication channel along a predetermined path of the alternate nodes.

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19 9. The method of Claim 1, wherein establishing an alternate path from the
20 second node to the first node comprises routing the destination-to-source
21 communication channel along a dynamically-generated path of the alternate nodes.

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23 10. The method of Claim 9, wherein routing the destination-to-source
24 communication channel along a dynamically-generated path comprises monitoring a
25 node status associated with potential alternate nodes, and selecting the potential
26 alternate node for inclusion into the dynamically-generated path if its respective node
27 status exhibits a predefined capacity of available information bandwidth.

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29 11. The method of Claim 10, wherein monitoring a node status comprises
30 monitoring a node address table of which the node status is a field thereof.
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1 12. The method of Claim 11, wherein monitoring a node address table
2 comprises monitoring the node status of at least the next two hops of nodes.

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4 13. The method of Claim 1, further comprising detecting the failed link at
5 the second node.

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7 14. The method of Claim 13, wherein detecting the failed link comprises
8 monitoring for a loss of optical power at a corresponding port of the node, and
9 detecting the failed link when the optical power reaches a predetermined threshold.

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11 15. The method of Claim 1, wherein the first node is an information-
12 originating source node from which the information transfer is initiated.

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14 16. The method of Claim 1, wherein the first node is an intermediate source
15 node between the failed link and an information-originating source node from which
16 the information transfer is initiated.

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18 17. The method of Claim 1, wherein the second node is a targeted
19 destination node to which the information transfer is ultimately directed.

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21 18. The method of Claim 1, wherein the second node is an intermediate
22 source node between the failed link and a targeted destination node to which the
23 information transfer is ultimately directed.

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25 19. The method of Claim 1, further comprising transmitting a failure
26 notification message from the second node to the first node via the destination-to-
27 source communication channel, wherein the destination-to-source communication
28 channel transmits the failure notification message from the second node to the first
29 node by way of the alternate path.
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1 20. The method of Claim 19, wherein switching the optical traffic flow at the
2 first node comprises switching the information traffic flow to the alternate path when
3 the first node receives the failure notification message, thereby allowing the disrupted
4 transfer of information to be switched to the alternate path when the first node is
5 apprised of the failed link.

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7 21. The method of Claim 1, wherein the destination-to-source
8 communication channel comprises one or more wavelengths dedicated to
9 transmitting management information, including a link failure notification.

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11 22. A network protection configuration for use in optical mesh network
12 topologies to reroute optical signals from a failed transmission path to one or more
13 alternate transmission paths, the network protection configuration comprising:
14 an optical fiber network comprising a plurality of optical network nodes
15 each coupled to transmit and receive optical signals carried on distinct wavelengths
16 on optical fibers of the optical fiber network, the optical network further comprising a
17 source node attempting to transmit the optical signals via the failed transmission path
18 and a destination node detecting the failed transmission path; and
19 a communication channel established from the destination node to the
20 source node to transmit a path failure notification, wherein a route established by the
21 destination-to-source communication channel traversing one or more of the optical
22 network nodes defines the alternate transmission path, and wherein the network
23 nodes defining the alternate transmission path are switched in response to the path
24 failure notification to facilitate source-to-destination transmission of the optical signals
25 from the failed transmission path along the alternate path.

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27 23. The network protection configuration as in Claim 22, wherein each of
28 the optical network nodes further comprises memory to store an optical node address
29 table, wherein the optical node address table maintains status information for
30 surrounding optical network nodes being within at least two hops of the optical
31 network node.

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2 24. The network protection configuration as in Claim 23, wherein the status
3 information comprises an optical node address for the surrounding optical network
4 nodes.

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6 25. The network protection configuration as in Claim 23, wherein the status
7 information comprises node availability information for the surrounding optical
8 network nodes.

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10 26. The network protection configuration as in Claim 23, wherein the status
11 information comprises node bandwidth capacity information for the surrounding
12 optical network nodes.

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14 27. The network protection configuration as in Claim 22, wherein each of
15 the optical network nodes further comprises a fiber cross-connect circuit coupled to
16 one or more of the optical fibers of the failed transmission path to switch the optical
17 signals corresponding to a failed optical fiber to fiber cross-connect output ports to
18 route the optical signals corresponding to the failed optical fiber to targeted optical
19 fibers along the alternate path.

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21 28. The network protection configuration as in Claim 27, wherein each of
22 the optical network nodes further comprises an optical cross-connect circuit coupled
23 to the fiber cross-connect circuit to switch at least one of the optical signals
24 corresponding to the failed transmission to optical cross-connect output ports to route
25 the at least one optical signal to targeted fibers in the fiber cross-connect for ultimate
26 transmission along the alternate path.

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28 29. The network protection configuration as in Claim 22, wherein the optical
29 fiber network incorporates wavelength division multiplexing whereby multiple optical
30 signals each transmitted at a different wavelength are transmitted on a single fiber.
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1 30. The network protection configuration as in Claim 22, further comprising
2 monitoring means for detecting the failed transmission path at the destination node.

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4 31. The network protection configuration as in Claim 22, wherein each of
5 the optical network nodes comprises switching means for rerouting the optical signals
6 corresponding to the failed transmission to optical fibers along the alternate path in
7 response to the path failure notification.

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9 32. A network protection configuration for use in optical mesh network
10 topologies to reroute optical signals from a failed transmission path to one or more
11 alternate transmission paths, the network protection configuration comprising:

12 an optical fiber network comprising a plurality of optical network nodes
13 each coupled to transmit and receive optical signals carried on distinct wavelengths
14 on optical fibers of the optical fiber network, each of the plurality of optical network
15 nodes comprising:

16 a fiber cross-connect circuit coupled to receive one or more of
17 the optical fibers of the optical fiber network and to switch the optical signals
18 on the optical fibers to particular output ports of the fiber cross-connect to
19 route the optical signals on the optical fibers to targeted optical fibers;

20 an optical cross-connect circuit coupled to receive one or more
21 of the optical signals and to switch the optical signals to particular output ports
22 of the optical cross-connect to route the optical signals to targeted ones of the
23 optical fibers;

24 a destination-to-source communication channel established from a
25 destination node detecting the failed transmission path to a source node to transmit a
26 failed path notification, wherein a route established by the destination-to-source
27 communication channel traversing one or more of the optical network nodes defines
28 the alternate transmission path, and wherein the fiber cross-connect and optical
29 cross-connect circuits of the network nodes defining the alternate transmission path
30 are switched in response to the failed path notification to facilitate source-to-

1 destination transmission of the optical signals from the failed transmission path along
2 the alternate path.

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4 33. A method for establishing a protection path for a failed optical link
5 between a source node and a destination node in an optical WDM mesh network,
6 wherein a transfer of optical signals from the source node to the destination node is
7 suspended by the failed optical link, the method comprising:

8 detecting the failed optical link at the destination node by recognizing
9 the loss of optical power at destination node cross-connect ports;

10 transmitting a link failure signal via a communication channel from the
11 destination node detecting the failed link to the source node through one or more
12 alternate nodes;

13 configuring a cross-connect switch at each of the alternate nodes
14 receiving the link failure signal, comprising cross-connecting input ports to output
15 ports of the cross-connect switch such that a source-to-destination protection path for
16 transmission of the suspended optical signals is established as the link failure signal
17 is transmitted from the destination node to the source node; and

18 switching the suspended optical signals from the failed optical link to
19 the source-to-destination protection path upon receipt of the link failure signal at the
20 source node, whereby the source-to-destination protection path is set up using a
21 destination-to-source communication channel.
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